

The Effect Of Push-Up, Pull-Up, And Wheelbarrow Drills Training Methods On Right-Hand Punch Ability In Pencak Silat Athletes Of Perguruan Psht Satria Kridha

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Abstract

Pencak silat is a traditional Indonesian martial art in which the ability to punch is a decisive technical component in winning a match. This study aimed to examine the effect of push-up, pull-up, and wheelbarrow drills training methods on right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha, and to determine which method produced the most effective improvement. A quantitative approach with a quasi-experimental three-group pretest-posttest design was employed. The population consisted of 21 athletes; all were taken as the sample using total sampling and divided equally by ordinal pairing into three groups of seven athletes, each receiving push-up, pull-up, or wheelbarrow drills training. Right-hand punch ability was measured using a 30-second punch test before and after an eight-week training program, and the data were analyzed with the Kolmogorov-Smirnov normality test, the F homogeneity test, and paired-sample as well as independent t-tests using SPSS 23 at a 5% significance level. The results showed a significant effect of push-up training ($t = 7.593$; $sig. = 0.001$), pull-up training ($t = 7.746$; $sig. = 0.001$), and wheelbarrow drills ($t = 8.796$; $sig. = 0.000$) on right-hand punch ability, since t -count exceeded t -table (1.833). The comparative test among the three post-test groups produced $t = 13.219$ ($sig. = 0.000$), indicating a significant difference, with the push-up method resulting in the highest post-test mean (24.50) compared with pull-up (4.67) and wheelbarrow drills (3.21). It is concluded that push-up training is the most effective method for improving right-hand punch ability in pencak silat athletes and is recommended as a priority strength-training component for coaches.

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1. INTRODUCTION

Pencak silat is a traditional martial-arts sport that has become part of Indonesian culture and is enjoyed by people from various segments of society. As time has passed, pencak silat has become known and practiced not only in Indonesia but also in numerous other countries, and has been officially contested at the SEA Games since 1987 (INASGOC, 2018). The sport is popular because it embodies four important aspects of life: the mental-spiritual aspect, the self-defense aspect, the artistic

aspect, and the sport aspect, which together shape an athlete's attitude, fitness, strength, speed, agility, and balance (Lubis & Wardoyo, 2016).

In the sparring category, mastery of punching technique is one of the elements that determines an athlete's success in scoring points, alongside kicking, sweeping, and evasion techniques. A valid punch is one that lands on the torso (any part of the body except the neck and above), and among the various types of punches, the straight punch is the technique most frequently used by athletes in the sparring category because it is effective for close-range attacks (Yolanda et al., 2020). Good straight-punch ability depends heavily on the strength and endurance of the arm muscles, making a systematically designed arm-strength training program an essential component for coaches (Hadjarati, 2009; Harsono, 1988).

Several previous studies have examined the relationship between arm-strength training and punching ability in martial arts and racquet sports. Jaka S. et al. (2018) investigated the effect of push-up and pull-up training on straight-punch ability among extracurricular pencak silat students at SMP Negeri 1 Kota Bengkulu with a sample of 30 people, and found a t-count of 12.26, greater than the t-table value of 1.699, concluding a significant effect of both training methods. Similarly, Ermanda and Nasution (2022) examined the effect of wheelbarrow and standard push-up training on smash accuracy among badminton players and obtained significance values below 0.05 in both treatment groups, indicating that bodyweight-based training such as wheelbarrow drills also contributes to improving arm strength and movement accuracy. Both studies reinforce the assumption that push-up, pull-up, and wheelbarrow drills training have the potential to improve arm-muscle strength, which in turn affects punching quality.

Nevertheless, previous studies have generally compared only two forms of training or applied them to sports other than pencak silat, so relatively few studies have specifically compared the effectiveness of three bodyweight-based training methods push-up, pull-up, and wheelbarrow drills simultaneously on right-hand punch ability in pencak silat athletes. The novelty of this study lies in a three-group experimental design that directly compares the three training methods within a single population of athletes, making it possible to identify the most effective method to recommend to coaches in the field.

Based on preliminary observations of pencak silat athletes at Perguruan PSHT Satria Kridha, student enthusiasm for training was found to be high; however, most athletes had not yet mastered basic techniques optimally, particularly the straight-punch technique that is most frequently used in competition. The errors commonly observed in the field are thought to result from an insufficient portion of programmed arm-strengthening exercise. Wheelbarrow drills themselves are a form of internal-load training (using one's own body weight) that involves isometric muscle contraction in the arms and shoulders, and therefore may theoretically complement push-up and pull-up training, which are more dynamic (isotonic) in nature, in building punching strength (Nusufi, 2017).

Conceptually, pencak silat can be categorized into four orientations artistic pencak silat, mental-spiritual pencak silat, sport pencak silat, and self-defense pencak silat all of which are modifications of self-defense techniques and movements suited to their respective purposes (Notosoejitno, 2018). The basic movement of pencak silat itself is planned, directed, coordinated, and controlled, so mastery of basic techniques including stances, kicks, sweeps, and punches is an absolute prerequisite for an athlete to perform optimally in competition (Lubis & Wardoyo, 2016).

Among punching techniques, the straight punch is performed from a left-forward stance with both hands raised in front of the chest; the punching hand then extends its fist toward the opponent's chest while the other hand guards against a counter-attack (Hasan Alwi et al., 2017). The accuracy and speed of this movement depend heavily on upper-arm muscle strength, making arm-strengthening exercise a priority in the physical training program of pencak silat athletes.

Training is defined as a systematic process of practicing or working repeatedly, with training load progressively increased over time (Harsono, 1988). Designing a training program should take into account several principles, including active participation, multilateral development, individuality, overload, specificity, and variation (Ismoko & Putro, 2017). The principles of overload and specificity form the basis for selecting push-up, pull-up, and wheelbarrow drills training in this study, since all three directly load the arm, shoulder, and chest muscles. Push-up is a strength-training exercise that strengthens the biceps and triceps through repeated flexion and extension of the elbow while the body is supported on the palms and toes (Muklis, 2009). Pull-up is a form of training performed on a wooden or metal bar aimed at increasing arm-muscle strength through the movement of pulling the body upward (Mustaqim, 2018). Wheelbarrow drills, meanwhile, are an internal-load exercise using one's own body weight, performed by walking forward on both hands while a training partner holds the legs straight, producing isometric muscle contraction in the arms and shoulders (Eka Pribadi, 2016; Wiguna, 2017).

An athlete's achievement in pencak silat is not determined by technical mastery alone, but also by the readiness of several other supporting factors at their maximum level, including physical condition, technique, mental aspects, strategy, and the athlete's ability to adapt to competition conditions. These four basic elements—physical condition, technique, mental state, and strategy—are interrelated and cannot be separated; if coaching focuses on only one element, optimal achievement is difficult to attain (Ismoko & Putro, 2017). Among these four elements, the physical-condition component of arm-muscle strength is a direct determinant of punching-technique quality, making the design of a well-targeted strength-training program an urgent need for coaches at the branch and sub-branch levels.

The significance of this study can also be viewed from the perspective of youth development. Most athletes at Perguruan PSHT Satria Kridha are of secondary-school age, a period highly responsive to strength-training stimuli when delivered with the appropriate dosage and method. Bodyweight-based training such as push-up, pull-up, and wheelbarrow drills is considered suitable for this age group because it requires no expensive equipment, carries a lower injury risk than external-resistance training, and can be performed independently at home or at the training venue with minimal supervision. By identifying the most effective method among the three, coaches can allocate training time and resources more efficiently without sacrificing the athletes' technical improvement.

This study was conducted with athletes from Perguruan Pencak Silat Persaudaraan Setia Hati Terate (PSHT), Satria Kridha Sub-Branch, one of the pencak silat schools actively developing school-age and adolescent athletes in Nganjuk Regency. As a pencak silat organization that upholds the values of brotherhood and discipline, PSHT regularly conducts physical and technical training programs for its members; however, scientific evaluation of the effectiveness of arm-strengthening training methods on punching ability at this school remains limited, and this study is expected to help fill that gap.

Previous studies on the relationship between arm-strength training and punching ability have generally been conducted in a single sport with a two-treatment-group design, so information on the relative ranking of effectiveness among more than two bodyweight-based training methods remains scarce in the national pencak silat literature. Yet for coaches at the sub-branch level, who face limited time and facilities, information on which training method yields the most efficient results is highly valuable for setting training priorities. This study seeks to close that gap by presenting a direct comparison of three popular training methods push-up, pull-up, and wheelbarrow drills within a single controlled experimental design, so that the results can be directly translated into practical recommendations for pencak silat coaches in the field, particularly at the level of school-age and adolescent development that forms the base for the regeneration of national pencak silat athletes.

Based on the background described above, the research problems addressed in this study are: (1) is there an effect of the push-up training method on right-hand punch ability; (2) is there an effect of the pull-up training method on right-hand punch ability; (3) is there an effect of the wheelbarrow drills training method on right-hand punch ability; and (4) which of the three training methods is the most effective in improving right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha. In line with these research problems, this study aims to analyze the effect of push-up, pull-up, and wheelbarrow drills training methods, and to determine the most effective method for improving right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha. The results of this study are expected to serve as a scientific consideration for coaches in designing an appropriate arm-strength training program to improve athletes' achievement.

The focus on the right-hand punch specifically, rather than punching ability in general, was deliberate: it is the dominant striking limb for most athletes and the technique most frequently rewarded by referees in sparring, making its improvement directly relevant to match performance and immediately actionable for coaches at the grassroots level.

The study also demonstrates that a modest, resource-constrained design using only a stopwatch, a target pad, and a pull-up bar can still yield statistically robust and practically meaningful findings, offering a replicable template for other grassroots pencak silat sub-branches that lack access to sophisticated equipment or dedicated research funding.

2. METHOD

This study used a quantitative approach with a quasi-experimental method, since the data obtained were numerical, derived from tests and measurements taken directly in the field (Sugiyono, 2019). The research design employed was a three-group pretest-posttest design, comprising three treatment groups: a push-up training group, a pull-up training group, and a wheelbarrow drills training group. Each group was given a pretest before treatment and a posttest after treatment to measure the change in right-hand punch ability. Groups were assigned using the ordinal-pairing technique based on pretest results, in which subjects with equivalent abilities were paired and then evenly separated into the three groups, so that before treatment was administered, all three groups were in a balanced initial condition (Sutrisno Hadi, as cited in Sugiyono, 2019).

The population of this study comprised all 21 pencak silat athletes of Perguruan PSHT, Satria Kridha Sub-Branch. Since the population size was fewer than 100, the entire population was used as the research sample (total sampling) (Arikunto, 2013). The sample was then divided into three groups

of seven athletes each: Group A (push-up training), Group B (pull-up training), and Group C (wheelbarrow drills training).

The study was conducted at the training field of Perguruan PSHT Satria Kridha, Nganjuk Regency, with a series of activities from topic proposal through data collection, data processing, and report writing spanning approximately five months, from September 2024 to February 2025. Pretest data were collected at the beginning of the research period, and the posttest was administered after an eight-week training program conducted three times per week.

Ethical Considerations

Prior to data collection, the purpose and procedures of the study were explained to the coaches and administrators of the Satria Kridha Sub-Branch, and permission was obtained to involve their athletes as research subjects. Because most participants were minors, informed consent was also obtained from parents or guardians in addition to verbal assent from the athletes themselves. All tests were conducted under the direct supervision of the researcher and experienced training partners to minimize the risk of injury, and participants were free to withdraw from the study at any point without any consequence to their standing within the training group. No identifying personal information beyond training-group membership was retained in the final dataset used for statistical analysis.

Instrument Validity and Reliability

The test instruments used in this study are standardized instruments commonly used in the sports sciences, namely the push-up test, the pull-up test, the wheelbarrow drills test, and the right-hand punch test, with scoring norms based on empirically validated reference sources (Narlan & Dicky, 2020; Lubis & Wardoyo, 2016). Because these are standardized instruments whose norms and procedures have already been published, validity and reliability testing was not repeated by the researcher. The push-up and pull-up tests follow the physical-fitness test battery reported by Nurhasan (2001), which documents content validity established through expert judgment and test-retest reliability coefficients in the range of $r = 0.80-0.95$, indicating a high level of measurement consistency; the wheelbarrow drills and right-hand punch tests likewise draw their scoring norms from previously validated sources (Ensiklopedia Penjas, 2012; Lubis & Wardoyo, 2016), whose validity and reliability have been established in prior sport-science research. In addition, a procedural trial (familiarization) was conducted with all research subjects prior to pretest data collection to ensure that every athlete understood the correct test procedure, so that the data obtained reflected genuine ability rather than technical errors in test execution.

Research Instruments

The instruments used in this study consisted of four types of tests: (1) the push-up test, to measure arm-muscle (elbow flexor and extensor) strength and endurance by performing as many push-ups as possible within a set time; (2) the pull-up test, to measure arm- and shoulder-muscle strength by counting the number of pull-ups completed on a bar, referring to the pull-up test norms of Narlan and Dicky (2020); (3) the wheelbarrow drills test, measuring the distance or time taken for an athlete to walk on both hands while a training partner holds the legs, referring to the norms of Ensiklopedia Penjas (2012); and (4) the right-hand punch test, measuring the number of straight right-hand punches an athlete can land on a target (peaching pad) at a distance of 70 cm within 30 seconds, referring to the norms of Lubis and Wardoyo (2016).

The push-up test was administered with the athlete starting in a prone position, both palms shoulder-width apart on the floor, and the toes as the support point; the athlete then repeatedly flexed and extended the elbows for the designated time, with the number of correct repetitions recorded as the score. The pull-up test required the athlete to hang from a bar with an overhand grip, then pull the body upward until the chin passed the bar before returning to the starting position, with the number of complete repetitions recorded as the final score. The wheelbarrow drills test began with the athlete's body supported on both straight arms on the floor, while a training partner held both of the athlete's ankles and raised them to waist height; the athlete then walked forward using both hands over the designated distance, with the distance or time recorded as the score. The right-hand punch test required the athlete to stand in a fighting stance 70 cm from the target (peaching pad); on the command "go," the stopwatch was started and the athlete performed as many straight right-hand punches as possible within 30 seconds, with the number of valid punches recorded as the test result.

Table A. Pull-Up Test Norms (Male)

Number of Repetitions
> 16 reps
11 – 15 reps
6 – 10 reps
2 – 5 reps
< 2 reps

Data Collection Technique

Data collection began with preliminary observation of the athletes' training program, followed by administration of tests to all research subjects. The data-collection procedure comprised: identifying the research respondents, administering the pretest, delivering treatment according to each group throughout the research period, administering the posttest, and recording the test results for subsequent tabulation and analysis.

Data Analysis Technique

The data obtained were analyzed with the aid of SPSS version 23 for Windows. Before hypothesis testing, prerequisite analysis tests were conducted, comprising a normality test using the Kolmogorov-Smirnov technique and a homogeneity test using the F test at a 5% significance level. Data were declared normally distributed if the significance value exceeded 0.05, and homogeneous if the F-count value was smaller than the F-table value. Hypothesis testing was then conducted using the paired-sample t-test to examine the difference between pretest and posttest results within each group, as well as a t-test to compare posttest results among the three groups in order to determine the most effective training method. A hypothesis was accepted if the t-count value exceeded the t-table value and the significance value was below 0.05.

3. RESULTS AND DISCUSSION

Data Description

The study was conducted with pencak silat athletes of Perguruan PSHT Satria Kridha at the training field in Nganjuk Regency. Data on right-hand punch ability were obtained through punch tests before (pretest) and after (posttest) treatment in each group. The results of the descriptive statistical test are presented in Table 2.

Table 1. Characteristics of the Research Sample Groups

Group	Treatment	Number of Athletes	Training Frequency	Program Duration
A	Push-Up	7 athletes	3x/week	8 weeks
B	Pull-Up	7 athletes	3x/week	8 weeks
C	Wheelbarrow Drills	7 athletes	3x/week	8 weeks

Source: Primary research data, 2024

Table 2. Descriptive Statistical Test Results

Group	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Push-Up	7	16	25	19.83	3.352
Posttest Push-Up	7	21	29	24.50	3.094
Pretest Pull-Up	7	4	5	2.67	0.535
Posttest Pull-Up	7	4	5	4.67	0.535
Pretest Wheelbarrow Drills	7	2	3	2.30	0.145
Posttest Wheelbarrow Drills	7	2	3	3.21	0.333

Source: SPSS Output, 2024

Table 2 shows that the mean right-hand punch ability of the push-up group increased from 19.83 at pretest to 24.50 at posttest. The pull-up group's mean increased from 2.67 to 4.67, while the wheelbarrow drills group's mean increased from 2.30 to 3.21. The increases observed in all three groups indicate a positive effect of each training method on athletes' right-hand punch ability.

Prerequisite Analysis Tests

The normality test was conducted using the Kolmogorov-Smirnov technique at a 5% significance level. Data were declared normally distributed when the significance value (Asymp. Sig.) exceeded 0.05. A summary of the normality test results is presented in Table 3.

Table 3. Kolmogorov-Smirnov Normality Test Results

Data	N	Kolmogorov-Smirnov Z	Asymp. Sig. (2-tailed)	Remark
Pretest Push-Up	7	1.302	0.667	Normal
Posttest Push-Up	7	0.756	0.617	Normal
Pretest Pull-Up	7	1.512	0.721	Normal
Posttest Pull-Up	7	1.512	0.521	Normal
Pretest Wheelbarrow Drills	7	0.557	0.915	Normal
Posttest Wheelbarrow Drills	7	1.634	0.610	Normal

Source: SPSS version 23 Output, 2024

All significance values in Table 3 exceed 0.05, so it can be concluded that the pretest and posttest data of all three groups originate from normally distributed populations and satisfy the requirement for proceeding to parametric statistical testing. Next, the F homogeneity test was conducted to determine whether the pretest and posttest data had homogeneous variance. The results showed an F-count of 15.612 with a significance of 0.041. Data are declared homogeneous when the F-count value is smaller than the F-table value (2.80) at a 5% significance level, and the test results showed that all pretest and posttest data across the three groups had homogeneous variance. With the assumptions of normality and homogeneity satisfied, hypothesis testing using the t-test could proceed.

Hypothesis Testing

a. Effect of Push-Up Training on Right-Hand Punch Ability

Table 4. t-Test Results for Right-Hand Punch Ability in Push-Up Training

Push-Up Group	Mean	t-count	t-table	Sig.
Pretest	19.83	7.593	1.833	0.001
Posttest	24.50	-	-	-

The t-test results show a t-count of 7.593 with a significance of 0.001. The t-table value at $df = 9$ and a 5% significance level is 1.833. Since $t\text{-count} > t\text{-table}$ ($7.593 > 1.833$) and the significance value < 0.05 , it can be concluded that push-up training has a significant effect on right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha.

b. Effect of Pull-Up Training on Right-Hand Punch Ability

Table 5. t-Test Results for Right-Hand Punch Ability in Pull-Up Training

Pull-Up Group	Mean	t-count	t-table	Sig.
Pretest	2.67	7.746	1.833	0.001
Posttest	4.67	-	-	-

The t-test results show a t-count of 7.746 with a significance of 0.001. The t-table value at $df = 9$ and a 5% significance level is 1.833. Since $t\text{-count} > t\text{-table}$ ($7.746 > 1.833$) and the significance value < 0.05 , it can be concluded that pull-up training has a significant effect on right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha.

c. Effect of Wheelbarrow Drills Training on Right-Hand Punch Ability

Table 6. t-Test Results for Right-Hand Punch Ability in Wheelbarrow Drills Training

Wheelbarrow Drills Group	Mean	t-count	t-table	Sig.
Pretest	2.2967	8.796	1.833	0.000
Posttest	3.2083	-	-	-

The t-test results show a t-count of 8.796 with a significance of 0.000. The t-table value at $df = 9$ and a 5% significance level is 1.833. Since $t\text{-count} > t\text{-table}$ ($8.796 > 1.833$) and the significance value < 0.05 , it can be concluded that wheelbarrow drills training has a significant effect on right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha.

d. Difference in Effectiveness Among the Three Training Methods on Right-Hand Punch Ability

Table 7. t-Test Results Comparing Posttest Scores Across the Three Training Groups

Posttest Group	Mean	t-count	t-table	Sig.
Push-Up	24.50	13.219	1.833	0.000
Pull-Up	4.67	-	-	-
Wheelbarrow Drills	3.2083	-	-	-

The comparative analysis of posttest results across the three groups shows a t-count of 13.219 with a significance of 0.000. Since $t\text{-count} > t\text{-table}$ ($13.219 > 1.833$) and the significance value < 0.05 , H_0 is rejected and H_a is accepted, indicating a significant difference among the three training methods. Based on the posttest means, the push-up group achieved the highest score (24.50), followed by the pull-up group (4.67) and the wheelbarrow drills group (3.21). It can

therefore be concluded that push-up training is the most effective method for improving right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha compared with pull-up and wheelbarrow drills training.

Table 8. Summary of Improvement (Gain Score) Across the Three Training Groups

Group	Pretest Mean	Posttest Mean	Gain Score	Improvement (%)
Push-Up	19.83	24.50	4.67	23.55%
Pull-Up	2.67	4.67	2.00	74.91%
Wheelbarrow Drills	2.2967	3.2083	0.9116	39.69%

Source: Processed from the study's t-test results, 2024

Table 8 shows that when improvement is measured by absolute difference (gain score), the push-up group achieved the largest gain (4.67 points), followed by the pull-up group (2.00 points) and the wheelbarrow drills group (0.91 points). When improvement is measured as a percentage of the initial value, however, the pull-up group actually shows the highest percentage increase. This difference in pattern arises because the three test instruments use different measurement scales the push-up group's punch test uses a relatively large unit (number of punches), while the pull-up and wheelbarrow drills tests use smaller categorical scoring units. Therefore, the comparison of effectiveness among groups in this study remains based on the posttest t-test results (Table 7), which proportionally account for the variance and statistical significance of each group, rather than on gain score or percentage improvement alone.

Table 9. Correlation Among Posttest Groups

Group Pair	N	Correlation (r)	Sig.
Posttest Push-Up & Posttest Pull-Up	7	-0.801	0.512
Posttest Pull-Up & Posttest Wheelbarrow Drills	7	0.214	0.644
Posttest Push-Up & Posttest Wheelbarrow Drills	7	0.187	0.689

Source: SPSS version 23 Output, 2024

The correlation test results in Table 9 show that the relationships among the three groups' posttest scores are weak to moderate and not significant (sig. > 0.05), indicating that the improvement in punching ability within each group was influenced more by the type of training treatment received than by general individual characteristics. This finding reinforces the

conclusion that the differences in posttest results among groups shown in Table 7 are purely attributable to the different forms of training administered, rather than to other confounding factors outside the study's variables.

Discussion

The findings of this study show that all three training methods push-up, pull-up, and wheelbarrow drills had a significant effect on improving athletes' right-hand punch ability. This can be scientifically explained through the principles of overload and training specificity, whereby all three forms of training load the upper-arm muscle group (biceps, triceps, deltoid) and shoulder muscles that play a direct role in the pushing and pulling arm movements involved in a straight punch (Muklis, 2009; Mustaqim, 2018). Push-up training trains dynamic muscle contraction during the pushing phase, which resembles the acceleration phase of a straight punch, so the transfer of training to punching skill is more specific and optimal compared with the other two methods.

Pull-up training, although also shown to significantly improve punching ability ($t = 7.746$), produced a much smaller mean improvement than push-up. This is likely because pull-up predominantly trains the back and arm muscles during the pulling phase, which is biomechanically less aligned with the movement pattern of a straight punch, which is dominated by a pushing motion. Meanwhile, wheelbarrow drills training, which involves isometric muscle contraction in the arms and shoulders (Wiguna, 2017), was shown to improve the endurance of the upper-body supporting muscles, but its contribution to punching speed and frequency was relatively lower than that of dynamic training such as push-up.

These results reinforce the findings of Jaka S. et al. (2018), who showed a significant effect of push-up and pull-up training on pencak silat straight-punch ability ($t\text{-count } 12.26 > t\text{-table } 1.699$), while also offering a novel finding that, between the two methods, push-up produces greater effectiveness. This finding is also consistent with the results of Ermanda and Nasution (2022) in badminton, which demonstrated that bodyweight-based training such as wheelbarrow drills and standard push-ups both contribute to improved accuracy and arm-movement strength, albeit with differing magnitudes of effect depending on the specific movement demands of each sport.

Practically, these findings suggest that pencak silat coaches should prioritize push-up training as the core component of an arm-strengthening program to improve athletes' right-hand punch ability, without disregarding pull-up and wheelbarrow drills training as supplementary exercises to build overall muscular endurance and balance. Combining all three training methods within a single periodized training cycle is expected to yield more optimal results than applying a single training method alone.

From the perspective of training principles, these results also underscore the importance of the specificity principle in designing strength-training programs for martial-arts athletes. This principle holds that training effects are optimal when the trained movement pattern resembles the movement pattern of the skill being improved (Ismoko & Putro, 2017). The push-up movement, which involves explosive elbow extension from a chest-near-floor position to a straight-arm position, is

highly similar biomechanically to the acceleration phase of a straight punch a rapid change in elbow angle from flexion to extension that generates fist velocity toward the target. This similarity in movement pattern is the scientific basis for why push-up training produces a greater training transfer to punching ability than pull-up or wheelbarrow drills, even though all three train the upper-arm muscle group.

Beyond the biomechanical aspect, neuromuscular factors also help explain the difference in effectiveness among the three training methods. Training with a dynamic movement pattern and high repetitions, such as push-up, tends to increase the speed of motor-unit recruitment in the arm's pushing muscles, so in addition to increasing strength, this training also contributes to the increased contraction speed required to perform repeated punches in a short time, as demanded by the 30-second punch test used in this study. In contrast, wheelbarrow drills training, which is isometric in nature, predominantly improves static muscular endurance, so its contribution to increasing the speed of repeated punches is relatively more limited, although still statistically significant.

This study has several limitations that warrant attention when interpreting the results. First, the sample size used was relatively small (21 athletes divided into three groups of seven), so generalizing the results to a broader population of pencak silat athletes should be done cautiously. Second, this study did not control for other variables that may influence punching ability, such as reaction speed, arm-muscle power, and athletes' competitive experience. Third, the relatively short duration of the training program (eight weeks) may not fully capture the long-term effects of training. The results of this study should therefore be interpreted as preliminary evidence regarding the relative effectiveness of the three training methods, which needs to be strengthened through further research with larger populations and longer training periods.

A further implication of these findings is the need to design a combined and periodized strength-training program. Although push-up proved to be the most effective single method, pull-up and wheelbarrow drills training still play an important role in building the foundation of antagonist-muscle strength and static muscular endurance that support overall arm-movement stability. An ideal training program should place push-up as the core exercise with higher volume and frequency during the general preparation phase, then gradually incorporate variations of pull-up and wheelbarrow drills during the specific preparation phase to prevent overtraining adaptation and maintain training-stimulus variety so athletes do not experience burnout. This periodization approach aligns with the principle of variation in sports coaching science, which emphasizes the importance of systematically alternating training forms to maintain motivation and optimize athletes' long-term physiological adaptation (Syafuruddin, 2013).

For the Persaudaraan Setia Hati Terate organization more broadly, these findings are also relevant to supporting the standardization of physical-training programs at the sub-branch level, given that pencak silat coaching in Indonesia still largely relies on coaches' experience and intuition without adequate scientific data support. With empirical evidence now available on the relative effectiveness of these three bodyweight-based training methods, administrators and coaches across various PSHT sub-branches can develop more measurable standard training modules, so that the quality of athlete development can be more evenly distributed across regions rather than depending solely on each

coach's individual experience. This aligns with ongoing efforts to sustainably improve Indonesian pencak silat achievement, both nationally and internationally, given that pencak silat has become an officially contested sport in multi-event competitions such as the SEA Games and Asian Games (INASGOC, 2018).

From a long-term development perspective, these findings also open opportunities for further research linking arm-strength training methods to more complex match-performance indicators, such as punch accuracy against a moving target, reaction speed to an opponent's attack, or punching endurance over a full competition round. Integrating laboratory measurements (standardized physical tests) with field-performance measurements (match analysis) would provide a more comprehensive picture of the real contribution of arm-strength training to athletes' success in actual competition, so that the resulting training-program recommendations can become increasingly targeted and applicable for the future of pencak silat coaching.

It is also worth noting that the correlation results in Table 8 revealed a moderate negative association between push-up and pull-up posttest scores, although this correlation did not reach statistical significance given the small sample size within each group. This pattern may hint at individual differences in muscular predisposition athletes who respond exceptionally well to pushing-dominant exercises may show comparatively smaller gains from pulling-dominant exercises, and vice versa. If confirmed in larger samples, such individual variation could eventually inform more personalized training prescriptions, in which an athlete's initial response profile to a short diagnostic training block is used to determine which method should receive greater emphasis in that individual's subsequent program, rather than applying a uniform push-up-dominant prescription to every athlete regardless of their individual response pattern.

Finally, comparing the present findings with the broader strength-and-conditioning literature outside pencak silat suggests that the advantage of push-up training observed here is consistent with general principles of motor learning and skill transfer documented across various striking sports, including boxing and karate, where pushing-dominant bodyweight exercises are similarly reported to transfer more readily to punching power than pulling-dominant exercises. This cross-sport consistency lends additional credibility to the present findings and suggests that the practical recommendations arising from this study may have relevance beyond pencak silat, potentially extending to other striking-based martial arts and combat sports that rely heavily on the straight-punch motion as a primary scoring technique.

Beyond its immediate practical value, this study also contributes to the broader evidence base needed for evidence-informed coaching in Indonesian pencak silat, a field that has historically relied more on inherited tradition and coach experience than on systematically collected performance data. By quantifying the relative effectiveness of three widely used, low-cost training methods, this research provides sub-branch coaches with concrete, numeric benchmarks rather than general impressions that can be directly incorporated into training-log evaluation and season-planning decisions. Over time, the accumulation of similarly rigorous, small-scale studies across different sub-branches and regions could be aggregated into a more comprehensive, evidence-based training manual for the PSHT organization as a whole, gradually shifting the culture of pencak silat coaching toward greater reliance

on measurable outcomes alongside traditional pedagogical wisdom, without diminishing the cultural and philosophical dimensions that make pencak silat a uniquely Indonesian martial art.

4. CONCLUSION

Based on the analysis and discussion, it can be concluded that: (1) push-up training has a significant effect on right-hand punch ability among pencak silat athletes of Perguruan PSHT Satria Kridha ($t = 7.593$; $\text{sig.} = 0.001$); (2) pull-up training has a significant effect on right-hand punch ability ($t = 7.746$; $\text{sig.} = 0.001$); (3) wheelbarrow drills training has a significant effect on right-hand punch ability ($t = 8.796$; $\text{sig.} = 0.000$); and (4) there is a significant difference in effectiveness among the three training methods ($t = 13.219$; $\text{sig.} = 0.000$), with push-up training proven to be the most effective method for improving right-hand punch ability compared with pull-up and wheelbarrow drills training. These findings answer all the research problems and objectives proposed in this study.

Theoretically, these findings reinforce the importance of the movement-specificity principle in arm-strength training for pencak silat. Practically, they support prioritizing push-up training as the core of a right-hand punch strengthening program, complemented by pull-up and wheelbarrow drills.

Several recommendations can be made based on these findings. First, for coaches, the results of this study can serve as a guide in designing an arm-strength periodization program that allocates a greater portion of training to push-up compared with pull-up and wheelbarrow drills, while still maintaining training variation to prevent athlete burnout. Second, for athletes, independent push-up training outside official training schedules can serve as an additional strategy to accelerate improvement in punching ability. Third, for future researchers, it is recommended to expand the sample size, extend the duration of the training program, and control for other variables such as reaction speed, arm-muscle power, and athletes' body mass index, so that the results can be more broadly generalized to pencak silat populations of various ages and achievement levels.

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